Listing of module reading assignments, lecture topics and activities for modules 1-5. The lecturer for the mini-lecture is indicated by the initials in ( ).

1: Molecular Manufacturing	*Reading*	"Voodoo Science, The Seven Warning Signs of Bogus Science," (Robert L. Park)[i] "Self Replicating Systems and Molecular Manufacturing," (Ralph Merkle)[ii]
	lectures	Ecology fundamentals (MR); Manufacturing practices (LV); Evaluating information and its sources critically (BS)
	activity	Critically evaluate Merkle reading against the criteria in the Park article and the mini-lecture material. Identify the statement in the Merkle reading that most undermines the scientific credibility of the document.
	Reading	"Little Big Science," *Sci. American*: Sept. 2001 (Gary Stix)[iii] "Machine-Phase Nanotechnology," *Sci. American*:Sept. 2001 (Eric Drexler)[iv] "Of Chemistry, Love and Nanobots," *Sci. American*:Sept. 2001 (Richard Smalley)[v]
	lectures	Molecular recognition and self-assembly in the context of DNA replication (MR); self-assembly of nanospheres and the role of scanning probe techniques (PS)
	activity	Based on the U.S. Federal government spending (budget data) and Health 2005 (Center for Disease Control), recommend the amount of an increase or decrease in spending for nanotechnology research. Provide three bullet points that justify your recommendation.
	Reading	"The Pirates of Illiopolis", *Orion* (Sandra Steingraber)[vi]
	lectures	Poly vinyl chloride chemistry and manufacture (LV)
	activity	Evaluate the data on PVC precursors in the EPA's Toxic Release Inventory. Using this data and the National Society of Professional Engineer's statement on ethics, identify the endpoint in a product life cycle for engineers' responsibility for the safety and welfare of the public.
2: Gold Nanoshells	*Reading*	"Science, Sustainability, and the Human Prospect," *Science* (Peter H. Raven)[vii] "Nanoshells: Gifts in a gold wrapper," *Nature Materials 2* (Mark L. Brongersma)[viii]
	lectures	Gold nanoshells for cancer (LV); Cell life and death and the influence of heat (MR)
	activity	Based on the data of cell protein activity versus temperature and mass analysis of human cells, compute the approximate thermal energy range needed per volume to kill cancerous tissue.
	Reading	"Immunotargeted Nanoshells," *Science* (Loo, Lowery, Halas)[ix] "Nanotechnology takes aim at cancer," *Science* (Robert F. Service)[x]
	lectures	Synthesis, process of gold-coated nanoshells (KC); cancer pathology (MR)
	activity	Based on the absorption efficiency data, compute the approximate energy of the near infra-red radiation that a patient would need to be exposed to in order to kill a cancer cell with gold-coated nanoshells.
3. Tissue Engineering	*Reading*	Hepatic Tissue Engineering (Chan, Berthiaume, Nath, Tilles, Toner, and Yarmush)[xi] Scaffolds for Tissue Fabrication (Peter X. Ma)[xii]
	lectures	Microfabrication techniques for tissue scaffolding (RS); liver function (MR); Artificial Implantable Liver devices (LV)
	activity	Based on the hepatocyte cell dimensions, microblood vessel dimensions and artificial liver design constraints listed in the reading, design an implantable tissue scaffolding for an artificial liver using planar microfabrication technology.
4. Microfluidic glucose sensor	*Reading*	"A new monolithic microbiosensor for whole blood analysis," *Sensors and Actuators* (J-H. Kim *et al.)*[xiii]
	lectures	Glucose, insulin regulation in the digestive system (Lars Tomanek); Amperometric sensors (LS); Type II diabetes pathology (MR)
	activity	Based on Center for Disease Control data on trends in early onset of Type II diabetes and federal budget data, identify a source of displaced funding and develop a strategy for increasing the public health and welfare around Type II diabetes and its effects.
5. Debates	*Topic 1*	RESOLVED: Health care products containing nanocrystalline particles should be allowed on the market before toxicology studies of the nanocrystalline particles.
	Topic 2	RESOLVED: Public funds should be expended for nanotechnology/biotechnology development even though access to treatment by lower-income sectors is less than high-income sectors
	Topic 3	RESOLVED: New technologies should be developed regardless of the potential uses these technologies may have so that the United States can maintain their technological advantage.

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[i] Park, Robert L., "Voodoo Science: The Seven Warning Signs of Bogus Science," *Chronicle of Higher Ed.* 49(21) B20 (Jan 31, 2003).

[ii] Merkle, R., "Self Replicating Systems and Molecular Manufacturing," www.zyvex.com/nanotech/selfRepJBIS.html (last accessed on May 1, 2006).

[iii] Stix, G., "Little Big Science", *Scientific American* (September 2001): 32-37.

[iv] Drexler, K., "Machine-Phase Nanotechnology," *Scientific American* (September 2001): 74-75.

[v] Smalley, R., "Of Chemistry, Love and Nanobots," *Scientific American* (September 2001): 76-77.

[vi] Steingraber, S., "The Pirates of Illiopolis," *Orion* vol 24, #3 (May/June 2005): 16-27.

[vii] Raven, P., "Science, Sustainability, and the Human Prospect," *Science* 297 (August 9, 2002): 954-958.

[viii] Brongersma, M., "Nanoshells: Gifts in a gold wrapper," *Nature Materials* 2 (May 2003): 269-297.

[ix] Loo, C., A. Lowery, N. Halas, J. West, and R. Drezek, "Immunotargeted Nanoshells for Integrated Cancer Imaging and Therapy," *Nano Letters* 5,4 (2005): 709-711.

[x] Service, R., "Nanotechnology Takes Aim at Cancer," *Science* 310 (November 18, 2005): 1132-1134.

[xi] Chan, C., F. Berthiaume, B. Nath, A. Tilles, M. Toner, and M. Yarmush, "Hepatic Tissue Engineering for Adjunct and Temporary Liver Support: Critical Technologies," *Liver Transplantation* 10,11 (November 2004): 1331-1342.

[xii] Ma, P., "Scaffolds for tissue fabrication," *Materials Today* (May 2004): 30-40.

[xiii] Kim, J-H, B-G. Kim, J-B. Yoon, E. Yoon, C-H. Han, "A new monolithic microbiosensor for whole blood analysis," *Sensors and Actuators A*, 95 (2002): 108-113.